continuous winding for an electromagnetic device such as a turbine driven generator, with a flexible winding which passes through slots in the stator. According to the Examiner, Siemens shows a stator with cylindrical opening winding slots with increasing radius in order to accommodate winding conductors having varying diameters. Thus, the Examiner concludes that it would have been obvious to have used the stator slot arrangement as taught by Siemens and to have modified the stator of Shildneck since such modification according to col. 1, lines 25-29 of Siemens would accommodate conductors having varying diameters and insulation thickness.

Claims 2,4,5 and 7 are rejected as above and further in view of Endomoto et al. According to the Examiner, Endomoto teaches a method of manufacturing a stator coil whereby the positions of the slot in the current layer have been filled, the cable winding then passes to the nearest adjacent slot. The Examiner concludes that it would have been obvious to use the winding methodology of Endomoto et al. and to have modified the stator arrangement of Shildneck, since such modification would lower the resistance of the coil by shortening the coil end portion.

Claims 8 and 10-11 are rejected as Claim 1 above and further in view of Elton et al.'565. The Examiner asserts that Shildneck in view of Siemens shows the invention except for the winding having a semiconducting layer. Shildneck shows a direct cooled cable winding for a machine. Elton et al. shows an electrical cable with an internal and an external grading layer of semiconducting pyrolyzed glass fiber. Thus it would have been obvious to employ the cable of Elton et al in the machine of Shildneck in view of Seimens.

The Examiner asserts that Elton et al.. teaches a filler material in the winding end portions to round them off and reduce stress.

Claim 19 is rejected as above and further in view of Breitenbach et al. According to the Examiner it would have been obvious to have used the outer metal sheathing of Breitenbach in the device of Shildneck in view of Siemens and Elton et al.

The rejection of the claims is respectfully traversed for the reasons set forth below.

It is believed that the combination asserted by the Examiner runs counter to the teachings and objectives of the Shildneck reference, the Siemens reference and the Elton reference. According to the reference, Shildneck relates to an improved continuous winding for an electromagnetic device, and more particularly to an improved form of flexible insulated conductor for an electric machine with an easily controllable leakage reactance and having direct cooling of the hollow cylindrical conductor. In addition, Shildneck desires to reduce the thickness required in the ground insulation by providing a conductor having a more uniform dielectric stress.. In addition, Shildneck desires to control leakage reactance without increasing the depth of the conductor slots. Shildneck further provides for transposition of the conductors by twisting the conductors about the axis of the cable.

It should be first understood clearly that Shildneck is not directed to a high voltage machine. Shildneck doesn't want to increase the radial depth of conductor slots and is using a rather thin layer of rubber insulation. He wants to reduce the thickness of ground insulation. He even makes a positive statement about the insulation system Col .4, line 40. High voltage would require Shildneck to increase the radial depth of the conductor slots in order to accommodate more winding turns necessary to achieve high voltage and also require Shildneck to have thicker insulation. Thus, the problems associated with high voltage operation are not even considered by Shildneck. Indeed, Shildneck desires to produce an improved machine operable at conventional voltages and currents. One of the features of Shildneck is described on column 5 lines 27-43 and also in Fig. 4. According

to Shildneck, as the conductors become progressively farther from the axis, they become less efficient. Accordingly, Shildneck provides an arrangement of conductors in the form of a matrix instead of constraining them to remain along radial lines. According to present invention it is necessary to have a high number of windings in order to obtain high voltage and thus, the implication in Shildneck is that high voltage is not desirable.

It is believed that Shildneck can only be used as a high current, low voltage machine in the manner asserted by the Applicants. The reference need not be explicitly limited when those of ordinary skill in the art generally know the limitations of the art. Applicants are prepared to file a declaration by an expert in machine design, based on his own knowledge and expertise, that Shildneck is directed to a low-voltage high-current machine.

Siemens, adds nothing to the combination. As shown in Figure 1 thereof, Siemens includes "a plurality of individually insulated slot conductors" (column 1, lines 18-19) shown as elements a_1-a_3 in Figure 1 in slots of a stator. The first conductor, conductor a_1, will have a lower potential, and therefore a thinner amount of insulation (insulation i_1) disposed around it. Likewise, separate conductors a_2 and a_3 include progressively greater amounts of insulation thereabout depending on the amount of electric potential developed on the separate conductors. The reason for using separate conductors in the machine in Siemens is so that if the different conductors become damaged, it is simple to replace a damaged section (column 1, lines 37-40). Also, applying progressively more insulation to conductors further from the core, enables those conductors with a low potential on them, not to have an unnecessary amount of insulation thereabout, while the outer conductors which have a higher potential will have a thicker insulation layer. Thus, Siemens is teaching away from the objective of Shildneck. Siemens explains that this graduation "ensures maximum utilisation of

space" (column 1, lines 34-36). Accordingly, a basic feature of Siemens that helps achieve a maximum utilization of space and facilitate the replacement of a damaged section, is to employ groups of conductors, that are "separately insulated" (column 2, line 59).

The Examiner asserts that one of ordinary skill in the art would use the cable winding of Elton '565 in the machine of Shildneck in view of Siemens. However, it should be noted that Elton does not disclose a cable winding for a machine. Elton discloses a conventional rigid winding bar with a pyrolyzed glass outer covering: and Elton discloses a transmission and distribution cable with a similar covering. These are separate applications which utilize a common component, pyrolyzed glass tape. One is used in a conventional winding and one is used in a conventional cable. Further, the discussion of the invention in Elton 565 differentiates among the various applications, so that one of ordinary skill in the art would understand that the idea in Elton 565 is to use a pyrolyzed glass tape in various systems, but not that the systems could be used together. All that is shown in Elton 656 is that the winding and the cable can have a common component. Elton does not teach that the cable and the winding are interchangeable. One of ordinary skill in the art in machine technology would not look to cable technology for solutions and vice versa. This is because, the problems associated with machines are different than the problems associated with transmission and distribution cables. The devices of one art cannot be directly substituted for the other. Nor can the systems simply be scaled up at will without creating new problems in the process. Although the schematic diagrams shown in the patents make the devices look simple, this is far from the truth.

A simple illustration may be useful. If one wishes to increase the voltage capability of a cable, one can make the insulation thicker almost without limit, except perhaps that at some point where the cable might become too heavy to carry its own weight or it would be too stiff to roll up on

a pay off reel. One could not simply use such a cable in a machine because it would be too inflexible and too large. More importantly however, that cable operates in an ambient environment and cooling is not generally considered an issue. Whereas in the present invention, the environment is relatively high temperature and overheating is a problem. So it is not obvious to substitute a distribution or transmission cable for a winding in a machine. In addition, it should be understood that transmission and distribution cables have metal screens and metal protective layers. If these are not removed, the cable would have increased current in the conductive layer(s) and would overheat. Also, the conductive layers would act as a conductor and would carry an induced voltage in response to the changing magnetic field.

Another feature of the Shildneck/Siemens combination asserted by the Examiner is the notion that the cable should be flexible so that it can be twisted and thereby produce transpositions in the conductors without resorting to the complicated strategies employed in conventional transposition schemes. The cable in Elton is not flexible, but is stiff as a result of the pyrolyzed glass tape layer. If however, the cable of Elton is employed in the winding of Shildneck alone, or in combination with Siemens, the result would not be in accordance with the teaching of Shildneck, which teaches that a flexible cable is inserted into the openings in the stator without any other modification. The resulting device using the cable of Elton '565 would not accomplish the results desired by Shildneck. Accordingly the combination suggested by the Examiner would not be operable.

In order for the covering of Elton 565 to be employed in the arrangement of Shildneck, one would have to wrap the conductor with the pyrolyzed glass tape layer as described in Elton 565, then surround that layer with insulation, and thereafter surround the insulation with another layer of semi-conducting material in the form of pyrolyzed tape. According to Elton 565, the intimate contact

between the insulation layer and the semi-conducting layer is achieved by a resin impregnation step. This implies that after the assembly is formed it is cured thereby becoming a solid layer. This process results in a stiff structure. On the other hand , if the substitution suggested by the Examiner is performed prior to the resin impregnation step, it would be necessary to draw an uncured structure through the openings in the stator. This could damage the structure contrary to the teaching of Shildneck and would require placing the winding and stator as a unit into a huge oven for curing the winding. Alternatively, if the winding structure is formed according to the teaching of Elton 565, one would produce a stiff cable which would not be sufficiently flexible or properly deform as desired by Shildneck. Accordingly, one of ordinary skill in the art would not be motivated to substitute the covering in Elton 565 for the insulation layer in either Shildneck alone, or in combination with Siemens.

An important feature of the present invention, which is not addressed in Shildneck or Siemens, is the fact that the electric field is confined by the outer semi-conducting layer. In Shildneck it is necessary to draw a cable through the opening at the stator. Even if one were to assume that it is possible to have good contact between the outer surface of the cable and the inner surface of the stator, the contact cannot be perfect. Indeed, the openings 2A and 5 in Shildneck are large enough to allow the cable to be pulled through. As a result the open surface the cable is only in partial or intermittent contact with the stator. Thus, at such locations which are not in contact with the stator, the electric field may be sufficiently high to produce partial discharge through the air to the stator wall. In the present invention, the outer surface of the cable is semi-conducting. As a result, the electric field at the interface between the insulation layer and outer semi-conducting layer is equalized throughout the outer semi-conducting layer. Thus, even though the outer layer is not

necessarily in full and intimate contact with the stator, there is no concentration of the electric field at the surface of the cable with respect to the stator. In other words, the electric field is confined within the cable and is equalized about the cable so that the electric field does not become concentrated at one point and flashover. In Siemens, the conductors are individually insertable in the corresponding openings. There is no suggestion in either reference that contact with the stator is a useful and beneficial result.

Shildneck does not even contemplate the possibility of controlling the electric field because Shildneck is only concerned with controlling the heat produced in a high current machine. The concept in Shildneck envisions only a relatively high current machine. This is why Shildneck requires a hollow conductor through which a cooling fluid is in heat exchange relation with the winding. In this connection, it should be understood that Shildneck employs a silicone rubber insulation which has the desired flexibility and good resistance to temperatures encountered in modern generators. See column 3, line 73 through column 4, Line 2. In other words, Shildneck must live with the problem associated with high thermal operation precisely because he is operating in a high current environment and at relatively low voltages. The present invention, on the other hand, operates in precisely the opposite way by providing a covering having a sufficient thermal conductivity to effectively remove heat. At the same time, the invention operates at high voltage and with relatively low current so that it does not produce the same kind of heat load that one encounters in the conventional arrangement of Shildneck in the first instance.

While it is tempting to make the logical leap as asserted by the Examiner, it should be understood that those of ordinary skill in the art did not jump to such a conclusion. The thinking in

the art, up until the time of the present invention was that radical solutions were necessary in order to produce a high voltage generator.

The conclusion of the Examiner that the combination would be obvious is further traversed because none of the references contemplate a high voltage machine. Certainly, Shildneck does not contemplate such a machine because he does not provide suitable insulation for such an arrangement. In fact, Shildneck suggests that the ground insulation be about 0.150 inch thick silicon rubber. In the present invention, the solid insulation is considerably thicker. Indeed in Shildneck the major portion of the cross section is conductor, whereas in present invention major portion of the cross section is the insulation. Siemens increases the insulation as the voltage goes up, but he does not use a cable, and indeed he teaches segmented winding components because he must change the insulation thickness as he increases the voltage.

It should be further understood that Shildneck is in fact satisfied with the insulation quality he has achieved - Shildneck is working with low voltage and doesn't have the need for improving the insulation. All Shildneck must do is to operate in the conventional realm. Nowhere does he suggest that the insulation should be increased in order to increase the ability of the material to withstand a high voltage. While it is true that Shildneck is using a round conductor to protect it from mechanical damage and handling, and to provide a conductor having more nearly uniform dielectric stress, Shildneck does this so that he can reduce the thickness required in the ground insulation. Column 2, line 16-62. Thus there is no motivation for Shildneck to improve increase the voltage of the machine above conventional levels. Therefore, there is no eviednce in the reference to combine it as the Examiner suggests.

Elton recognizes that in the end winding region of an electric machine that there will be problems caused by strong electric fields. As a solution, Elton describes using a known grading near the stator to allow some of the accumulated charge to bleed off to the stator, thus reducing the risk of arching. Elton uses rigid bar type windings which are able to withstand mechanical stresses caused by induced fields between the winding in the end winding region, where electromagnetic fields are not contained in the winding. The mechanical rigidity of the bar type windings suppress the amount of vibration in the end winding region that would otherwise be present. The fact that a grading system is used to lessen the end winding region problems in Elton is further evidence that Elton does not suggest using the cable of Fig. 7 as a winding of a machine, since such a cable would not have a grading.

Also in Elton 565, it is instructive to note that the filler material is specifically provided at the upper and lower ends of the stack of conductors forming the conventional rigid bar winding. Indeed, Elton 565 suggests that the filler material is only useful at these locations. See col. 7 lines 6-11. In the present invention, again the opposite is true, namely that the semiconducting layer is formed around the winding. Thus, Elton 565 has different configurations for different applications, one in a high current machine, and a separate one for a transmission and distribution cable. There is no suggestion that such a cable would be useful in a high current machine; and there is ample evidence that those skilled in the art would not have been persuaded that such an arrangement would have been useful if one were to attempt to make a high voltage machine. Indeed the very idea of a high voltage machine is not even suggested. Such a device would require a whole new set of operating parameters, as evidenced by the teachings of the invention.

In this connection, it is believed that it is hindsight reasoning to employ the teaching supplied by the Applicant as the motivation from combining the prior art. The motivation must come from the prior art itself. Even if one considers the general knowledge of one of ordinary skill in the art one cannot assume that such a person of ordinary skill would be motivated to employ known elements where there is no reason to do so.

Applicants further traverse the rejection based on the combination asserted above and with the addition of Endomoto et al. The reference is for reducing the size and resistance of the winding by providing a shaped and looped closer to the end face of the core. The particular drawing figures cited by the Examiner show a convoluted end winding which would, if used in a high voltage machine, exhibit the same problems that a conventional machine would exhibit, namely high field stress where the coil ends change direction. In the present invention, the coil ends are simply looped from one opening to the next. It is possible to do this because the field is confined in the cable. Endomoto et al takes a different approach by forming the coil ends in shapes designed to reduce the current path and thereby reduce resistance. The present invention is not as concerned about the resistance of the conductor as the confinement of the field. Thus it is not necessary to follow the teaching of Endomoto et al. Further, the reference does not suggest a threaded winding as in the invention, but forms windings and then inserts them into the core through the slots. It is believed therefore that the rejected claims are patentable. Further, it is believed that the claims are themselves patentable as depending from a patetable main claiim.

With respect to the rejection of claim 19 as above in view of Breitnebach et al., the applicants respectfully disagree with the Examiner. Breitenbach is employed in a linear machine, which is a totally different structure than the type of machine contemplated in the present invention. The idea of

using a conductive screen or sheath in a rotating machine would be completely alien to the use of a conductive screen as described in Breitenbach. This is because, Breitenbach operates only when the moving part, i.e. the train, is in a limited part of the track. In other words, the heat buildup and power utilization is spread out over the entire rail system. In the invention, the winding is compact, and the possibility of overheating is increased when a metal screen or sheathis employed. Accordingly, it would not be obvious to use such a structure in the invention because it would tend to overheat. Indeed, any transmission and distribution cable with a metal screen or sheath would have the same tendency, and would not be an obvious choice.

Applicants assert in general that the combination of references asserted by the Examiner is improper in light of the standard regarding such a combination, set forth in In Re Geiger, 815 F.2d at 688, 2 USPQ2d at 1278 (Fed. Cir. 1987). This standard is that "[o]bviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." Id. The art fails to teach the combination.

The Examiner has not shown that a high voltage machine is produced in by the combination of Shildneck and Siemens. The addition of Elton adds nothing because the teaching of Elton is directed to the use of a particular material in three different applications. The reference does not suggest that the elements which would benefit from the material disclosed in Elton would themselves be interchangeable. Accordingly, there is nothing in the art cited by the Examiner which would suggest the asserted combination, because the combination does not result in the invention, i.e. a practical high voltage machine.

Furthermore, Applicants note that the MPEP § 706.02(j) states that one criterion that must be met to establish obviousness is that there must be a reasonable expectation of success. This criterion cannot be met when the aforementioned references are combined.

There is no likelihood of success in modifying the winding of Shildneck with Siemens and the cable 100 of Elton et al. because the increasing size of Siemens makes the winding too large, and the brittleness of Elton's cable would cause the winding to fail. As further noted the secondary references do not further enhance the basic combination asserted by the Examiner.

For these reasons, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

Respectfully submitted,

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AMENDED CLAIMS (MARKED UP)

Claim 1. (Twice Amended) A stator winding for a rotating electric machine having a stator , a rotor and air gap therebetween, the stator having end surfaces and a plurality of radial slots extending between the end surfaces to hold the winding in layers at different radial distances from the air gap, the winding comprising a cable passing to and from once through the stator between different layers forming a corresponding coil having an arc-shaped coil end protruding from each end surface of the stator, each of the coils bridging a corresponding number of slots and being divided into coil group parts, all of the coils in the same coil group part being arranged axially, one outside the other with substantially coinciding [centres] <u>centers</u> and with successively increasing diameters, and wherein the number of slots that are bridged by each of the coils successively increasing within the coil group part.

Claim 2. (Twice Amended) A stator winding as claimed in claim 1, wherein the stator has a yoke and the cable produces a formation passing from a first one of said first slots to a second one of said slots, and upon returning to the first slot, the cable changes position to a next layer in a first direction until a number of positions in the slot have been filled, and said cable then passes to a nearest adjacent slot [to form coils that lie to a side of the cable ;and coils included in the coil group are disposed in the same formation].

Claim 10. (Twice Amended) A rotating electric machine as claimed in claim [9] 1, wherein the winding comprises at least one current-carrying conductor, a first layer having semi-conducting properties around the conductor, an insulating layer around the first layer, and a second layer having semi-conducting properties around the insulating layer.